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Steel

Cleveland, Ohio

c1930

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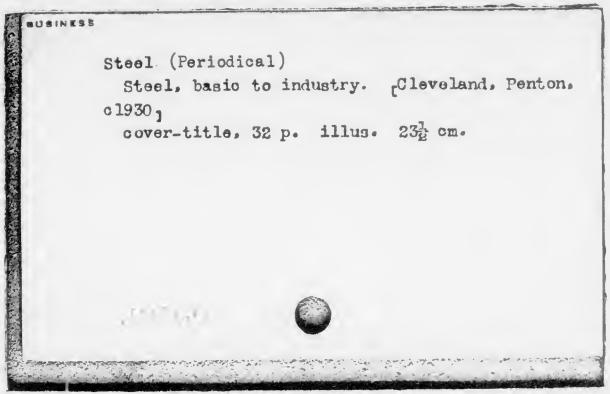
BUSINESS

Steel (Periodical)
Steel, basic to industry. [Cleveland, Penton, c1930]
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STEEL

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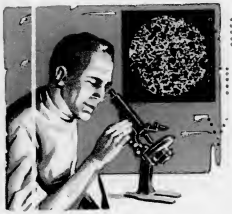
1

WHAT IS STEEL?

WERE some occult power unforseenly to banish all the gold from this world, a new standard of values would speedily be devised and commerce would proceed uninterrupted. For coal, oil, wood, rubber, cotton, silk, wool—in fact practically all basic materials—substitutes are now available or could expeditiously be developed. But without steel, present day standards of civilization could not be maintained.



Metallurgists, seeking a definition of scientific exactness, describe steel as a form of iron produced in fluid state, quite free from slag and containing, as a general rule, not over 1.50 per cent of carbon. The absence of slag in quantity differentiates steel from wrought iron and the low carbon content distinguishes it from cast iron.

But outside the classroom and laboratory, steel is robed with significance extending far beyond the scope of its chemical and metallurgical aspects. In the world at large it is all things to all men.

To the steelmaker it is the teeming white liquid which issues from the electric, bessemer or open-hearth furnace. To the rolling mill superintendent it is the cherry-red ribbon, which, gliding gracefully along the run-out table, starts its devious journey to the service of man.

To the engineer and manufacturer it is the material which makes possible all structures, transportation, communication, and other necessities of modern civilization. To the machinery builder it is not only the material of construction but also the tool by which machines fashion this material to useful shape and size.

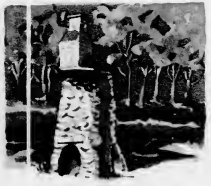
But steel is more than a basic material. To hundreds of thousands of wage earners the word connotes a necessity of life, the production, fabrication, distribution and use of which, directly or indirectly provides employment. To other thousands it is an industrial giant, who, using their money for his furnaces and mills, yields a fair return on their investments. To still other millions, unattached through wages or dividends, steel is emblematic of industrial greatness, of intense struggles for supremacy, of dramatic engineering achievement and of traditions unrivaled for romance in the history of American industry.

And so steel is an entity of such diversified personification that its story cannot be told in terms of a prosaic material. If therefore in the following pages, steel seems to take on the character of a real personage, it is because steel, the material, has become a dominant, intimate, virile force in the economic and social life of the nation.

2

Iron and Steel in America

THE story of steel is the drama of an age-old struggle to extract iron from its ore and to refine, shape and treat it for economical use In America, until the closing years of the Civil war, this struggle consisted of numerous and widely scattered attempts to produce a suitable metal from local ores in blast furnaces and puddling furnaces, and in Catalan forges. So numerous were these primitive ironworks that travelers, instead of inquiring for the nearest village, asked, "How far is it to the next forge?"



Early in the nineteenth century it became evident that the approach to metal of the desired quality lay not in the direct process of the Catalan forge but in the intermediate production of pig iron. The successful use of coke spurred blast furnace development, but not before charcoal, raw anthracite and raw bituminous coal had served successively as the prevailing fuels. In the meantime the introduction of the hot blast stove, improved furnace equipment and practice and the increasing utilization of high grade Lake Superior iron ores had given the blast furnace industry the impetus that was to carry it steadily forward as the backbone of the steel industry.

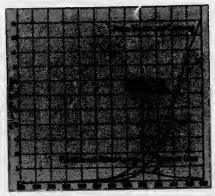
During the first 88 years of the American republic the only finished products of iron or steel were bar iron, simple iron castings and blister and crucible steel. It is a curious fact that despite the early facilities for its manufacture, the output of wrought iron did not assume importance until after steel had gained considerable headway.

The first steel in this country was made laboriously from bar iron. According to an early industrial census, 917 tons of this "blister" steel was produced in 1810. The first noteworthy venture to make crucible steel was in 1832, when the Girrard brothers established a crucible steelworks in Cincinnati. However, the industry languished until 1861, when the Morrill tariff helped American producers to gain a footing against imported crucible steel.

Before touching upon events that were to change the entire outlook for steel, it is well to view the early period in terms of production statistics. The following is the approximate output in gross tons:

Year	Pig Iron	Bar Iron	Steel
1810	53,908	24,541	917
1820	20,000	*	*
1830	165,000	96,621	*
1840	286,903	197,233	*
1850	563,755	443,711	6,078
1860	821,223	513,213	11,838

* Figures not available



These figures indicate the hopelessness of trying to supply iron and steel to the growing republic from the forge, puddling mill and crucible furnace. They also emphasize the importance of what was to come in 1864 and 1870.

The first intimation that the industry was soon to be freed from its limitations came with the invention of the pneumatic process of making steel, announced in 1856 by Sir Henry Bessemer in England and William Kelly in America. The same year Robert Mushet's perfection of the process by introducing spiegeleisen after the blow gave it practicality.

Fruition of these inventions came in September, 1864, when the first bessemer steel was made in America in an experimental works at Wyandotte, Mich.

INTENTIONAL SECOND EXPOSURE

2

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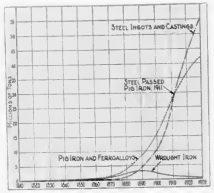

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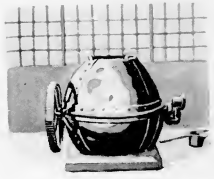

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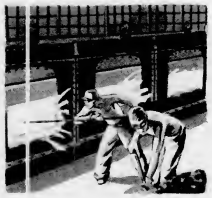
The converter was abandoned after a few years, but not before it had furnished the ingot for the first steel rail to be rolled in the United States by the North Chicago Rolling Mill. By 1867 there were three bessemer steelworks in the country and in that year 3000 tons of bessemer steel was produced.



Almost before the excitement of these developments had died down, the new product was threatened by a rival. While Bessemer and Kelly were announcing their invention, the brothers Siemens were developing their regenerative gas furnace, essential in open-hearth practice. The subsequent work of Dr. Charles Williams Siemens and of Emile and Pierre Martin resulted in establishing the process on a practical basis. In 1868 Frederick Slade built the first open-hearth furnace in America at Trenton, N. J., for Cooper, Hewitt & Co. Two years later a furnace was in operation at the Bay State Works, South Boston. With a modest production of 1,339 tons in 1870, open-hearth steel was off on its race with bessemer steel and wrought iron.

At this stage of development, most of the iron and steel was used for rails, nails, and castings. Railroad activity, due to the extension of western lines shortly after the Civil war, was a great incentive to iron and steel production. Numerous mills were erected to roll wrought iron blooms into rails, and until 1877 the production of iron rails each year exceeded that of steel. The rolling of wrought iron for this purpose declined steadily from that date and was finally abandoned in 1911. Wrought iron for other purposes continued in demand, and while production has receded gradually from a peak in 1904, it still is preferred for numerous applications. The recent commercialization of the Aston process, by which

wrought iron is made by "shotting" refined iron into specially prepared slag, is attracting new attention to this old product.

Meanwhile, stimulated by the growth of industry, the race between bessemer and open-hearth steel continued at accelerated pace. From an annual output of less than 70,000 tons in 1870, steel leaped to a total of ten million tons in 1900. In the same period, the annual production of pig iron rose from slightly over a million to more than thirteen million tons.

Spectacular though this rise in the last thirty years of the nineteenth century may seem, it was inconsequental in contrast to the development since 1900. The figures for the 59-year period follow:

Year	Pig Iron Including Ferroalloys	Wrought Iron	Steel Ingots and Castings
1870	1,665,179	1,291,000	68,750
1880	3,835,191	2,332,668	1,247,335
1890	9,202,703	2,920,367	4,277,071
1900	13,789,242	2,200,000	10,188,329
1910	27,303,567	1,740,156	26,094,919
1920	36,925,987	1,377,566	42,132,934
1929	42,613,983	475,049	56,433,473

Behind this statistical record are a number of significant developments, the influence of which will continue to affect the trend of steel for some time.

Hidden in the remarkable rise of blast furnace production is the influence of iron ore. The percentage of Lake Superior ore to the total mined in the country rose steadily to a peak almost 86 per cent in 1919, from which it has receded only slightly. By-product coke, which from the turn of the century gained headway as a blast furnace fuel, in 1919 displaced beehive coke in annual tonnage. Within the past few years blast furnace stacks, with 27-foot hearths, improved stoves and blowing apparatus, and consuming scrap in increasing quantity, have averaged more than 1000 tons daily over considerable periods. Engineers declare that the 1500-ton stack is not far in the future.

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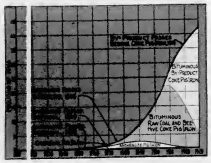
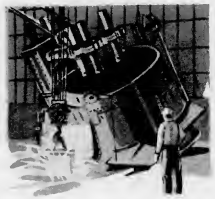
Other changes in ironmaking not evidenced by statistics are the sharp reduction in the number of active stacks and the decline of the merchant furnace industry. Today less than 200 stacks in blast can break monthly output records that were not even approached a few years ago when more than 400 stacks were operating. Only a few strictly merchant furnaces remain, and the control of these is closely concentrated.



These developments have deprived ironmaking of its one-time independence and have allied it more closely with steel. As a consequence, the prestige of pig iron production as a barometer of industrial activity has been somewhat impaired, although a decreasing number of economists still swear to its infallibility. Nevertheless the blast furnace, although shorn of much of its earlier glory, today still remains steel's most faithful handmaiden.

As early as 1900 the rivalry between open-hearth and bessemer steel was tending toward a decision. In 1908, open-hearth production overtook that of converter metal. Since that time the breach has widened until now the annual tonnage of open-hearth ingots and castings is nearly seven times that of its former rival.

The eclipse of bessemer ushered in a new steelmaking process. Electric furnace steel, almost a novelty in 1910, is gradually gaining its spurs. Its first million-ton year is near at hand.



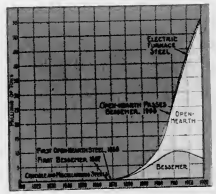
On the basis of present knowledge, the open-hearth process seems destined to hold its position of leadership for

TO INDUSTRY

many years. Among its advantages over the bessemer process are its ability to utilize a greater variety of raw materials including scrap, increased output of steel per ton of pig iron, better control, high tonnage output per furnace heat and freedom from phosphorus limitations in the pig iron charged. The basic bessemer converter requires pig iron with a phosphorus content of 2.00 per cent or more, while the basic open-hearth permits the use of iron of any phosphorus content. In this distinction lies the chief economic basis for the popularity of the American basic open-hearth process, since it uses vast ore deposits which otherwise could not be employed in steelmaking.

The present use of bessemer steel is confined to wrought pipe, cold-drawn bars and to a lesser extent several other finished products. The trend in bessemer production during the past decade has not changed appreciably, and it may be expected to continue as an important process secondary to open-hearth.

Due chiefly to ease with which the chemical reactions can be controlled in the electric furnace, electric steel has almost superseded crucible steel. The future of the electric process depends to an important degree upon the extent to which it is utilized in the production of alloy steels. Since 1909, the annual tonnage of alloy steel ingots and castings has increased steadily until now it is approaching four million tons. Probably two-thirds or more of this output is made in open-hearth furnaces. It remains to be seen whether the corrosion, heat and abrasion-resistant steels, now in ascendency, will lend themselves to open-hearth manufacture or will require the more sensitive handling afforded by the electric process.



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STEEL · · · BASIC TO INDUSTRY

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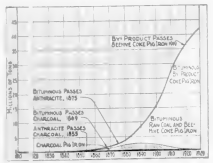
BY-PRODUCT PASSES BESSEMER CONE PIG IRON HERE
BITUMINOUS PASSES ANTHRACITE, 1875
BITUMINOUS PASSES CHARCOAL, 1849
ANTHRACITE PASSES CHARCOAL, 1853
CHARCOAL PIG IRON
BITUMINOUS RAW COAL AND BEE-HIVE COKE PIG IRON
BY-PRODUCT COKE PIG IRON

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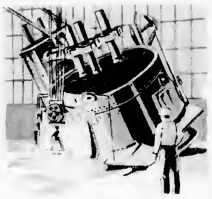

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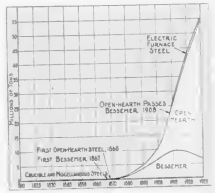


3

The Adaptability of Steel

EVOLUTION of steel in America through two centuries has brought many refinements in quality of the metal and in the form in which it is finished for use.

Instead of bar iron, castings and crude steel of colonial days, we now have 12 distinct classifications of commercial iron and steel:

Iron

(a) Cast
1. Gray iron castings
2. Malleable cast iron

(b) Puddled
3. Wrought iron

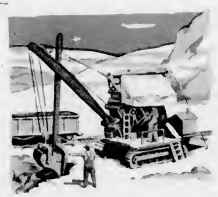
Steel

(a) Cast
4. Open-hearth
5. Bessemer
6. Electric
7. Crucible

(b) Ingot
8. Open-hearth
9. Bessemer
10. Electric
11. Crucible
12. Duplex

Each of the twelve fulfills an important mission in industry. The cast irons and steels pass from the foundries directly into service, except for machining and assembling operations. The route of wrought iron from puddling mill to use so nearly parallels that of steel that the two materials will be considered as one.

If all steel worked from ingot form were of the same composition, steelmaking would be a simple problem of tonnage. But steel is such a versatile material and lends itself so readily to chemical and physical manipulation that it is made in thousands of different analyses, each designed to give it the requisite properties for a specific use. It is this adaptability of steel which on one hand makes it the master servant of man and on the other induces the steelmaker to extend his functions far beyond those of mere production.



Today the influence of the steel industry logically and actually begins in the mining and preparation of ore, fuel and raw materials and extends through production, mechanical working, finishing, treatment, fabrication and distribution to the point where steel is incorporated in a manufactured product or sold to an ultimate user.

Gradual refinement has resulted in the classification of steel into three recognized groups. The first and most important from a tonnage standpoint is plain steel, comprising the various grades of carbon steels. The second, alloy-treated steels, are carbon steels to which a small amount of other elements is added for improvement but without strikingly affecting its characteristics. The third and now increasingly important group embraces the alloy steels, in which one or more elements other than carbon are introduced for the purpose of distinctly changing the characteristics of carbon steel. The infinite variety of steels resulting from these changes in composition is illustrated in the accompanying classification chart.

STEELS CLASSIFIED ACCORDING TO COMPOSITION

Plain Steels	Alloy-Treated Steels	Alloy Steels		
		Ternary Steels	Quarternary Steels	Complex Steels
Dead Soft Containing less than .10 per cent carbon and from .20 to .50 per cent manganese.	Carbon steels to which another element (or elements) are added to improve their quality but not to radically change their characteristics. Commonly used elements are aluminum, copper, phosphorus, sulphur, chromium, silicon, titanium, molybdenum, tungsten, and vanadium, in addition to manganese. Alloy-treated steels usually are of the low or medium carbon grades.	(Containing one alloying element and carbon.) Chrome Steels Manganese Steels Molybdenum Steels Nickel Steels Silicon Steels Tungsten Steels Vanadium Steels	(Containing two alloying elements and carbon.) Chrome-Molybdenum Steels Chrome-Nickel Steels Chrome-Vanadium Steels	(Containing more than two alloying elements and carbon.) Many varieties, mostly high speed steels such as chrome-tungsten - vanadium - cobalt steel.
Low Carbon Containing .10 to .30 per cent carbon and less than .60 per cent manganese.				
Medium Carbon Containing .30 to .55 per cent carbon and less than 1.00 per cent manganese.				
High Carbon Containing more than .85 per cent carbon, but seldom more than 1.50 per cent carbon and .40 per cent manganese.				
Ingot Iron				

STEEL · · · BASIC

If ingots could be reduced to a single form serving all purposes of consumption, the hot and cold working processes of the industry would be comparatively simple. As it is, the number and type of rolling mills are increasing steadily. New ideas are being introduced so rapidly that it would be a bold observer who would attempt to predict the methods by which steel will be rolled even 10 years hence.

Except for that which goes directly into large forgings or are otherwise hammered or pressed to shape, all steel in ingot form is reduced in rolling mills to blooms, slabs or billets. These in turn are rolled into billets, sheet bars or skelp (to be further reduced) or into plates, rods, bars, bands, hoops, shapes, rails and numerous other products. Some blooms then go into forgings or into specialties such as car wheels, shells and circular shapes. Sheet bars are reduced to sheets and skelp is shaped into tubes and pipe. An increasing tonnage of billets is consumed in the manufacture of seamless tubes.

Many of the mills on which these forms of finished steel are rolled are highly specialized and therefore can be used for only one product. A heating operation must be introduced between each rolling operation. Each finished product, with few exceptions, is furnished in numerous gauges, dimensions and shapes. With these complications in mind, it is apparent why steel requires a gigantic complement of furnaces, mills and accessories for hot and cold rolling and finishing. Likewise it is clear that while American steelmakers annually make and sell around forty million tons of finished iron and steel, it passes to consumption in so many compositions, forms and sizes that in diversity of product, steel probably excels Woolworth, Kresge, et al.

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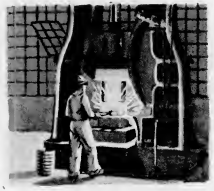
We have seen how variety of composition and form has extended the usefulness of steel. For many purposes the inherent strength of rolled steel is all that is desired, but since 1890 engineers have recognized more and more the advantages of heat treatment.

Until that year the use of heat to improve or change the physical properties was confined to toolmaking. The increasing demand for metal of unusual strength, ductility, toughness, hardness, machinability or resistance to impact soon focused attention on heat treatment. During the past quarter century development has been so rapid that today it is possible to prescribe and actually carry out with extreme accuracy the treatment best fitted to give steel any reasonable combination of physical properties.

Almost every type of steel can be improved by heat treatment, but the best results are achieved by correlating and reconciling both chemical analysis and heat treatment. For this reason alloy steels invariably fall short of giving their potential value of service unless they are heat treated. This fact is so important that numerous patents covering special steels, while silent or indefinite as to chemical composition, are specific and binding in regard to heat treatment.

The familiar heat treatment processes are annealing, normalizing, hardening, tempering or drawing, carburizing, case hardening, cyaniding and nitriding. Annealing and normalizing of the higher grades of sheet steel now is standard practice. In recent years the more important castings, most forgings and many stamped and drawn articles are annealed to relieve internal strains produced in mechanical working or uneven contraction in cooling.

The other operations are employed principally to increase strength, hardness, toughness and resistance to shock. Nitriding, newest development in case hardening, is attractive because it involves low temperatures and imparts superior hardness properties. Its popularity is attested by the fact a number of new steels, especially adapted to the process, have been introduced.



Modern finished rolled steel is adapted to numerous mechanical forming operations much more intricate and severe than were imposed several decades ago. Today a large proportion of sheet and strip steel is stamped or pressed. Much of the rod and bar stock is forged to shape in bolt headers, bulldozers and other types of automatic forging equipment. Plates undergo strenuous shaping operations in powerful bending rolls and hydraulic presses.

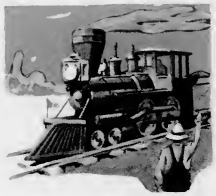
Until recently riveting occupied an undisputed position in the field of steel fabrication. Today it has a rival in welding, but thus far the new method has made greater progress in connection with stamped products, pressure vessels, machinery details and tubular goods than in large plate and structural steel construction. The rise of welding is quickening progress in all arts of forming and fabricating metals and to this extent is contributing to the exploitation of steel.

Where steel is exposed to corrosion, its resistance to this attack can be multiplied many times by covering it with a protective coating. Galvanizing provides an economical treatment for sheets and many stamped or forged articles. Tinning, as in the case of tinplate, is the most effective protection for food containers. Steel's ability to take platings of copper, nickel, chromium, glass, enamel, rubber and other substances has greatly extended its use in the chemical industries and for decorative or ornamental purposes.

4

Steel's Service to American Industry

STEEL, available in unlimited combinations of chemical composition, form, size and physical properties did not gain its present proud position of master metal unaided. While serving other industries it acquired invaluable experience and much needed support from them. And in this process of give-and-take extending over a period of many years, the progress of steel has become so intricately interwoven with that of every important industrial development that the two are inseparable.

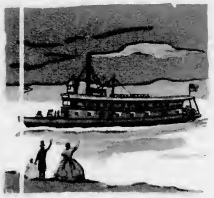


It was steel, successor to wrought iron, which in the period of western expansion during the seventies and eighties of the last century enabled the railroads to tap the productive agricultural region of the middlewest. And it was steel in the form of plow, seeder, harrow, mower, reaper and thresher, which in lieu of labor then unobtainable, so enormously increased the acreage a man could harvest that western farmers became the premier provisioners of the world.

Progress in transportation and agriculture—assisted by the availability of steel—made possible the widespread diffusion of population and stimulated the development of mineral resources, thereby furnishing the foundation for manufacturing on an important

scale. American genius for invention and capacity for organization, working in this environment of special opportunity, brought forth prompt results.

The steam engine was improved. Steam and water turbines were invented and developed to a degree of surprising efficiency. Electricity, the unknown, was made available first for lighting, then for power and later for heat. As power was made cheaper and more convenient, the equipment in manufacturing establishments grew in size and in scope of accomplishment. Machine tools kept pace with the requirements of increasing capacity and accuracy. The pulse of industry quickened. More and more dependence was placed on machinery. Gradually America was forging to the front rank among world powers in manufactures.

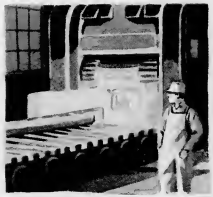


Throughout this advance, working hand-in-hand with every important industry, was steel. Step by step it had kept pace with agriculture, transportation, power, machinery, shipping, building and the many smaller divisions of commercial activity. Together they had created a complex industrial mechanism, resourceful, powerful, experienced and unshackled by many of the traditions of Old World economics.

The hidden potentialities in this great mechanism became apparent shortly after the turn of the century when the automobile, following a few years of experimental development, emerged as a product of manufacture demanding the best of materials, technical skill of the highest order, the most efficient methods of plant operation and the smoothest co-ordination of production, distribution and sales. If the motor car had been thrust upon industry as it existed in 1875, its advance to its present state of development would have been painfully slow.

Youthful and vigorous, the automobile industry profited from all that was good in the pool of experience gained so laboriously by agriculture, railroads, machinery, etc. Consequently its progress was rapid, and as it gathered momentum, it created new ideas which in turn were adopted by other industries. As a result of this free interchange of experience, which Europeans declare is a significant characteristic of American industry, research, invention, operation and management have been so far advanced that today a new product can be designed, introduced and marketed to the far ends of the world in less time than was required fifty years ago to work out a minor detail of design. The speed with which electrical refrigeration, the radio and other recent developments progressed to maturity is ample proof of this statement.

How closely the advance of steel has paralleled the rise of those industries which are contributing most heavily to modern American civilization is shown by statistical history. The trend of the production of steel ingots and castings is practically identical to that of value of all manufactures, when allowance is made for variations in the worth of money. By all other criterions, steel stands side-by-side with every movement of industry.



It is practically impossible to present an adequate picture of the diversified applications of steel. Five thousand uses of sheet steel have been tabulated, but the list is incomplete. An equal number of applications of strip steel could be compiled, while the enumeration of articles in which bars and wire

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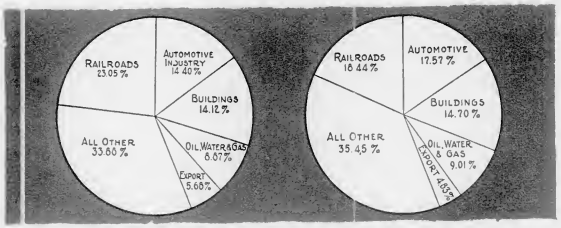
products are employed would be a hopeless, if not an impossible task.

Distribution statistics do not afford a satisfactory indication of the wide diffusion of steel among the articles of modern civilization, but they show where steel is consumed in important quantity. The distribution of total finished rolled iron and steel to the principal consuming groups is shown in the accompanying charts.



Average, 1922-29, inclusive — Distribution for 1929

In comparing the 1929 figures with the average for eight years, it is apparent that the trend of railroad consumption and exports has been downward, while the ratio of steel used by the automotive industry; buildings; oil, water and gas; and "all other" has increased. The gradual rise of consumption under the "all other" classification is significant, since it reflects progress in the broader diversification of applications of steel. An indication of the distribution of steel by products is afforded by the following tabulation:

	1922	1923	1924	1925	1926	1927	1928	1929
Railroads	24.96	31.02	27.54	22.26	22.81	20.37	17.02	18.44
Automotive	14.84	10.59	11.37	14.60	15.09	13.34	17.76	17.57
Buildings	11.83	13.53	14.44	15.26	13.10	14.89	15.22	14.70
Oil, gas and water	8.93	10.60	8.43	8.03	9.29	8.90	7.72	9.01
Export	7.83	6.22	5.89	4.47	5.29	5.33	5.52	4.83
All other	31.56	28.04	32.33	35.36	34.42	37.11	36.76	35.45

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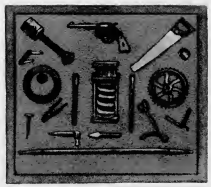
Perhaps the best indicators of the penetration of steel into modern life are the production and consumption per capita. The output of steel in the United States is equivalent to ten times the weight of every man, woman and child within its borders, or 1034 pounds per individual. If to production we add imports and subtract exports, thereby ascertaining consumption, we arrive at 999 pounds per capita, a figure far above that of important European countries.

From these and other indicators, it is clear that steel is a dominant factor in American life. Its availability at economical price and in abundant volume is the base from which the industrial pyramid of this age rises to the capstone of the most comfortable civilization the world has known.

Take away steel and immediately you surrender the automobile, the railroad, the steamship, the multi-storied building, the long-span bridge, the lasting highway, machinery of all descriptions, low-cost methods of producing and transmitting power, light and heat.



There is no steel in bread, but behind the loaf are the mechanized farm and bakery. There is no steel in the printed page, but consider the typesetting machine and the press. Radio, the telephone, practically every concomitant of life today in which steel is not visible are, however, dependent upon it for their production. It is a truism that where steel is not the component, it is the means.

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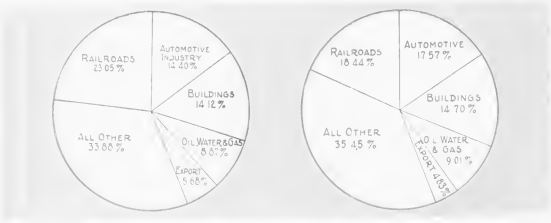

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Buildings ...	11 83	13.53	14.44	15.26	13.10	14.89	15.22	14.70
Oil, gas and water..	8.93	10 60	8.43	8.03	9.29	8.90	7.72	9.01
Export.....	7.83	6.22	5.89	4.47	5.29	5 33	5.52	4.83
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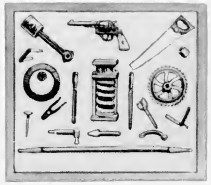

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5

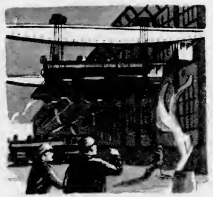
The Steel Industry Today

STEEL'S importance to the maintenance of present day standards of living makes the production, treatment and finishing of this material for use the outstanding and one of the most essential industries of America. The business of steel is so tremendous and its ramifications extend into so many devious channels that the layman seldom grasps a true picture of the physical aspects of the industry in its entirety.

The best way to comprehend the actual scope of the steel industry is first to visualize its functions. Stated briefly, they embrace extracting and preparing materials; converting and refining them into pig iron, steel ingots and castings; rolling the ingots; and preparing for use the resultant rolled steel, castings and forgings by drawing, stamping, pressing, heat treating, machining, welding, riveting, plating, polishing, etc.

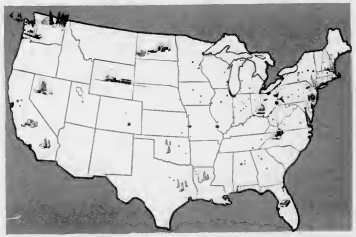
If each steelmaker performed all of these functions in his own plants, the task of appraising the extent of the industry would be fairly simple. Unfortunately for this purpose, however, only a fraction of American steel progresses from raw material to finished state in the plants of a single company. The great bulk of tonnage represents steel that has passed through the furnaces, mills and shops of two or more companies before it is ready for use.

This point is important, because failure to recognize its significance gives rise to many misconceptions as to the true scope of the steel industry.



For example, take the case of a steel producer who manufactures numerous products of steel, including automobile brake drums and locomotive driving wheel axles. At the same time, this steelmaker may sell steel to an automobile company, which uses it to make brake drums in one of its own plants, and to a locomotive builder which transforms the steel into axles in its works. The operations by which the steel is formed, treated and finished in the automobile and locomotive plants are identical with those employed by the steel company and are just as essentially a function of the steel industry as if they were performed in steelmakers' shops.

In these two instances the path of steel from maker to use is short. Frequently the steel producer sells to a specialist in cold drawing, who sells it to a manufacturer of screw machine products, who in turn passes his product to a heat treating, plating or polishing jobbing shop, from where it goes to the final user—probably a machinery or automobile builder. All of these successive operations, to the point where the part is incorporated in the finished machine, are legitimate functions of the steel industry.



With this explanation, it is clear that the true domain of steel extends beyond the blast furnaces, steelworks and rolling mills, which represent only the producing branch of the industry, and far into the thousands of plants where manufacturers—shaping, treating and finishing steel for use—are performing functions which are naturally and logically complementary to the making of steel.

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THE STEEL INDUSTRY

	a Total number of establishments	*b* Value of products	*c* Number of important establishments
1. *Blast furnaces, steelworks and rolling mills*			
Blast furnaces	116	$ 708,904,238	116
Coke (not including gas or utilities)	171	382,012,617	166
Steel works and rolling mills	486	2,779,840,238	486
Totals	773	3,870,757,093	768
2. *Steel products* *			
Bolts, nuts, rivets, washers, nails, spikes, horseshoes, wood screws, drawn wire, wrought pipe, etc.	344	391,214,940	257
Cast iron pipe	82	95,088,622	73
Doors, shutters and window sash metal	117	65,279,973	59
Forgings	209	103,672,231	115
Foundry and machine shop products	8,318	2,259,794,443	3,350
Galvanizing, electroplating, enameling and japanning	589	30,024,045	59
Screw machine products	205	48,137,867	83
Springs	94	43,820,633	56
Stamped and enameled ware	365	141,793,184	201
Steel barrels, kegs and drums	39	24,104,669	29
Structural and ornamental iron and steel	1,284	440,376,360	590
Tools, files, cutlery, saws and hardware	1,485	437,974,378	581
Wire work	512	128,535,783	172
Totals	13,643	4,209,817,128	5,665
3. *Manufactured articles of steel*			
Agricultural implements	277	202,732,126	132
Airplanes and parts	70	21,161,853	29
Cars and general construction and repairs in railroad repair shops	2,309	1,289,695,158	1,150
Cars not made in railroad shops	135	312,508,598	118
Carriages, wagons and sleds	250	51,131,328	125
Cash registers	41	106,844,969	27
Clocks and time recorders	52	38,195,803	22
Electrical machinery	1,777	1,637,307,035	917
Engines, turbines and water wheels	215	367,878,588	148
Firearms	20	19,452,372	16
Gas machines, gas and water meters	58	36,715,190	38
Locomotives	17	76,719,403	17
Metalworking machinery including machine tools	417	191,261,792	240
Motor vehicle bodies and motor vehicle parts	1,213	1,151,426,365	575
Motor vehicles, except motorcycles	264	2,848,442,843	236
Motorcycles, bicycles and parts	29	21,454,149	28
Plumbers supplies (Not vitreous enamel)	231	148,878,970	163
Pumps and pumping equipment	278	130,591,191	140
Refrigerators, mechanical	22	96,513,649	20
Safes and vaults	25	18,439,550	24
Scales and balances	60	24,655,442	38
Sewing machines	41	45,221,816	23
Shipyard and boat building	559	211,127,067	220
Steam fittings and steam and hot water heating	232	225,158,390	164
Stoves, ranges and warm air furnaces	564	258,285,829	345
Textile machinery and parts	367	116,921,130	149
Typewriters	75	69,111,992	40
Washing machines, wringers, ironers, etc.	75	74,951,338	50
Windmills and towers	16	7,514,149	11
Totals	9,689	9,800,298,085	5,205
Grand Totals	24,105	17,880,872,306	11,638

*Excluding products of similar character made in steelworks or rolling mills which are covered in (1).

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The only authoritative figures covering all divisions of the industry embraced in the foregoing definition are those of the bureau of census, United States department of commerce. From the biennial census of manufacturers of 1927, the latest data available, we derive the following summary:

	a Total number of establishments	*b* Value of products	*c* No. of important establishments
1. Blast furnaces, steelworks and rolling mills.	773	$ 3,870,757,093	768
2. Steel products*	13,643	4,209,817,128	5,665
3. Manufactured articles of steel	9,689	9,800,298,085	5,205
Totals	24,105	$17,880,872,306	11,638

* Excluding products of similar character made in steelworks and rolling mills, which are covered in (1).

Column *a*, above and in the detailed table on the opposite page, shows the number of establishments according to the census reports. As a rule, an "establishment" is a single plant, but in some cases it refers to two or more plants under common ownership in the same locality. On the other hand separate reports are occasionally obtained for different industries in the same plant.

Column *b*, showing value of products, is presented chiefly to indicate the comparative volume of business conducted by the various divisions of the industry. There is considerable duplication in the totals.

The census includes figures for every establishment in which the annual value of products exceeds $5000. Obviously many of the smaller plants are unimportant in purchasing power, volume of production and capacity to utilize capital and employ labor. Investigation of the census figures for a period of years shows that in the steel industry 36 per cent of the establishments account for 98 per cent of the total value of products and nearly 97 per cent of the total number of persons engaged in the industry.

This fact was kept in mind in compiling Column *c*, in which the small, unimportant establishments were omitted. Also in Class 3, "Manufactured Articles of Steel," many establishments were excluded because steel was not the dominant material used in manufacture.

With these adjustments, the steel industry resolves itself into a great structure of 11,638 worthwhile establishments. If we add

to these the several hundred plants hidden in the census figures for other industries (such as metal furniture in "forest products") and those in which it is difficult to separate steelworking operations from activities in other materials, we arrive at 12,000 as a conservative round total of important establishments.

The size of this great industry is apparent when its physical characteristics are compared with those of all manufacturing industries in the United States. The figures are from the 1927 census of manufactures.

	a Total of all manufacturers	*b* Steel industry (total)	*c* Steel industry (important plants only, estimated)	Per cent column *c* to column *a*
Number of persons engaged	9,787,647	3,076,502	2,900,000	28.8
Rated horsepower	39,045,940	14,937,670	14,000,000	35.9
Value of products	$62,718,347,289	17,880,872,306	16,750,000,000	26.6

Capital invested in the manufacturing industries has not been ascertained since the decennial census for 1919 was compiled, at which time the total for the United States was $44,197,722,282. The present capital investment in the steel industry is estimated at from $14,000,000,000 to $16,000,000,000.

From these comparisons it is apparent that steel is responsible for more than a quarter of the nation's industrial activity. Its operations affect every industrial community of the nation. Its ore properties in the upper lake region, in Alabama, Colorado and other sections; its coal mines in Pennsylvania, Illinois and other states; its blast furnaces, steelworks and rolling mills, concentrated largely in the territory lying east of the Mississippi and north of the Ohio, but with important units in the South and on the Pacific Coast; its forge shops, foundries, machine shop and manufacturing plants, again in greatest number in the northeast states but also well distributed in the chief centers of population throughout the nation; its privately operated railroads and freight vessels and other auxiliary activities—all of these employ capital and labor and purchase materials, fuel, transportation services, equipment and supplies in such volume that the steel industry, without question, is the world's largest industrial market.

6

Iron Trade Review

PRIOR to the advent of the factory system, when the nation's manufacturing activity still consisted largely of neighborhood, household and hand industries, instruction in the trades usually was handed from master to apprentice without the assistance of the printed word. But when hand power was supplanted by steam, the railway took the place of canal and carriage, and manufacturing became organized on the factory system, the word of mouth transfer of information was found to be inadequate.

For a time, the printed booklet was brought into service, but the frequency of changes required by the rapid progress of industry made that method impractical. Periodical publication of information became necessary, and to meet this need the American business paper came into being.

It was the demand for information of this kind in the iron and steel industry which led to the establishment of Iron Trade Review. Born at the time when the earliest beginnings of American steelmaking were apparent, and from a beginning as crude as that of the industry which gave it direction, character and breadth, this publication has advanced toward constantly higher objectives of publishing service until it has established itself in its present rank as one of the nation's leading business papers. Its policies have been as secure and as consistent as steel itself. It has dedicated itself to the progress and upbuilding both of the industry devoted to the making of steel and of that tremendous and ramified area of American manufacturing which accepts its leadership from steel; which taking steel as a plain material, transforms it into

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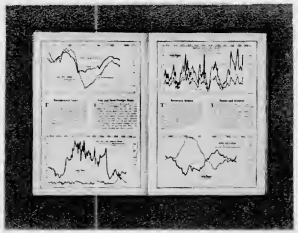
machines, parts and accessories demanded almost without limit by the prodigious development of the mechanical arts in the United States; and into the unending list of useful articles upon which human comfort and advancement are based in this modern age.

Probably in no way have the economic function and power of Iron Trade Review been illustrated more strikingly than in the weight and completeness of its market reporting. When this service was undertaken practically 50 years ago, trading in steel largely was an affair of private barter. Unequal and preferential rates, not unlike the old system of railroad rebates, were the common practice. Sales or purchases were regarded as the business of nobody except those directly involved. Success in manufacturing turned on the inside price that a buyer was able to wheedle out of a producer or conversely, which the producer gave to those consumers he favored. Accepted moral law in business in those days was purely that of expediency and the survival of the fittest. In this iron and steel was no different than the other large business enterprises of the time.



Against these conditions, Iron Trade Review and other agencies have waged a long and persistent struggle, winning favor by the sheer economic value of the service being rendered, and opening many doors to frank and confidential discussion of transactions and trade practices where they had been closed tightly for years to anything savoring of newspaper inquiry. Ultimately by the constant integrity and wholly independent methods of its reporting, Iron Trade Review became a leading influence in bringing the markets for iron and steel into the light of open day. Today scarcely a transaction of size in iron and steel is consummated where all the pertinent market facts are not made available to those to

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whom the details are important. Probably no industry in the world is so comprehensively or so accurately served with current market information and analysis as iron and steel in this country.

Thereby Iron Trade Review has established itself as a world authority, has won the general confidence of both buyers and sellers, and has exerted a stabilizing effect upon the whole fabric of the industry which has proved highly beneficial to both producers and consumers. The acceptance of its authority and the practical application of this service are attested by the contracts running into many millions of dollars, based on its quotations at the initiative of both buyers and sellers.

Iron Trade Review has stimulated and guided the scientific and manufacturing development of the steel industry and its related branches by seeking out and transmitting information pertaining to new inventions, improvement of processes, refinements of practice, etc. In common with other publications, it has been a factor in almost entirely eliminating the "trade secret" bugaboo from American industry. It has uncovered, chronicled and interpreted news events large and small, which had their significance and importance to its industry. It has originated and amplified statistics of its industry and has reduced them to graphs or other intelligible forms for the quick understanding and guidance of the executives and managers who constitute the main body of its readers.

Iron Trade Review has been the author and originator of an impressive number of editorial features and services, the evaluation of which economically has been proved by their perpetuation in constantly improved form, by their adoption in whole or part by competing publications, and by their recognition by government agencies, financial institutions, economic and statistical organizations, etc. One of these is the Business Trend section, in which the fundamental factors of industrial business, dependent on steel are graphed weekly for the guidance of management executives. Another is the development of the statistics of annual distribution of steel among consuming industries. Last year producers of 98 per cent of the finished steel tonnage of the country broke up and re-

ported their shipments to Iron Trade Review in the manner prescribed by it. Monthly statistics of steel ingot output, now regarded as the most important and significant statistical report available to the steel industry and aligned business, was started by Iron Trade Review. Another innovation in the discharge of editorial responsibility to its field was the organization, ten years ago under staff management, of a European news bureau, whereby the industrial life and changes of the Old World are interpreted in American style for American business.

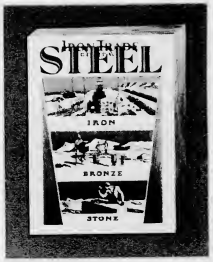
Numerous other distinctive methods of originating and presenting text values have marked the leadership of Iron Trade Review in its field of usefulness and have given it a character and individuality among business publications wholly its own.

In progressing with the steel industry for nearly half a century, Iron Trade Review occasionally has found it desirable to alter its editorial functioning in order to meet anticipated changes in the major problems of the industry. At one period, Iron Trade Review placed special emphasis on its descriptions of equipment and processes for the production of pig iron and steel, because at that time such information was in great demand. For a long time, the iron and steel market reports constituted Iron Trade Review's most important service to readers. Today, with markets tending toward stabilization and with the market and price reporting system firmly established, special emphasis on this phase of editorial service no longer is necessary.

Since the war, the attention of the industry has swung toward the application and distribution of steel and toward external economic factors which affect the use of steel. Anticipating this shifting of interest, Iron Trade Review gradually modified its editorial functioning to meet the new conditions. Adjustments of this kind are in process almost continuously. Therefore in looking to the future, the editors of Iron Trade Review ask themselves this question: "What will be the major problems of the steel industry within the next few years, and what can Iron Trade Review do to assist in solving them effectively?"

"Steel"

CHANGE and movement are the new order of the day. Perhaps at no time in history have revolutionary developments in industry appeared with such frequency and surprising celerity as they are today. According to the recent report of the President's committee on economic changes, current industrial events are characterized by acceleration and intensified activity.



This is especially true of the steel industry. Almost every day an important discovery is announced in alloy steels, in improved or new processes, in the design or construction of equipment or in methods of management. Long established practices may be swept away overnight by the sudden appearance of a new idea. Tradition trembles before the might of this new tempo of economic change.

These conditions are reshaping the character of the steel industry. Just as surely as steel has emerged through 65 years of history as the towering, all-pervading product of an industry that was once dominated by iron—just as certainly will present and future influences recast the industry in a new mold. We cannot foretell the destiny of steel, but existing developments point clearly to significant trends.

For instance, the steel industry has reached the stage of growth where it is equipped to meet any reasonable demand for its product.

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It is a safe assumption that from now on as much or more attention will be given to consumption development as was accorded the problems of production in the past. From numerous activities, still conducted quietly and without great publicity, it is apparent that the industry is on the threshold of an era of market research and intensive merchandising.

Steelmakers are beginning to realize that steel, the material, can be used advantageously in many articles where other materials now are employed. Likewise they know that other metals, such as copper, aluminum and perhaps nonferrous alloys not yet developed, will be pitted against steel in certain markets. These competitive situations call for a more intelligent exploitation of steel, which involves activities that will carry the industry into new lines of effort.

The successful exploitation of steel will necessitate more and better co-ordinated scientific research, improved relations between the steel industry and the public, continued and if possible greater efficiency in production, revolutionary changes in methods of merchandising, and finally throughout the rank and file of the personnel of the industry a greater knowledge, a higher appreciation and a more enthusiastic consciousness of the qualities and merchandising possibilities of steel.

To exploit steel effectively is the biggest task confronting the industry today. It towers head and shoulders above all other problems, most of which are routine questions of long standing. Nothing that the industry can do will be more certain to insure continued growth, stability of operation and enhanced earnings than the energetic promotion of steel.

This task challenges the best resources of the industry. It calls not only for the co-operation of all interested companies and business organizations, but also for the guidance, co-ordinating influence

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and inspirational force of an agency equipped with authority and ability to lead the industry toward its objective. The functions of such an agency are best performed by a business paper.

Consequently Iron Trade Review dedicates itself more emphatically to the exploitation of steel. As an initial step, its publishers have discarded the name "Iron Trade Review" and beginning with the issue of July 3, 1930, the publication which has carried that name for nearly 50 years, appears under the name "Steel."

The advantages of the new name are obvious. The old name, acquired at a time when iron was a dominant influence in the industry, has been outgrown. Steel in its various aspects is the thread of common interest running through practically all the editorial contents. Steel is the common factor of reader interest. Steel defines the scope and purpose of the publication more accurately than any other word. Steel is the dynamic key word of the industry served.

Concurrent with the change in name, the format, arrangement of editorial and advertising pages, typography, and other physical characteristics of the publication "Steel" have been improved.

More flexible printing schedules have made it possible for the first time to distribute the editorial pages so that the news articles and information of greatest interest to the largest number of readers are more accessible. A digest enables the busy executive, with only a few minutes at his disposal, to "high spot" the week in steel. "Mirrors of Motordom," one of the most widely and closely read features of any business paper, is given a more prominent position. Greater opportunity is afforded for effectively presenting and interpreting major news items. The Business Trend is increased in effectiveness through the use of color. The market reports are presented in more legible form. Prices are quoted in larger type.

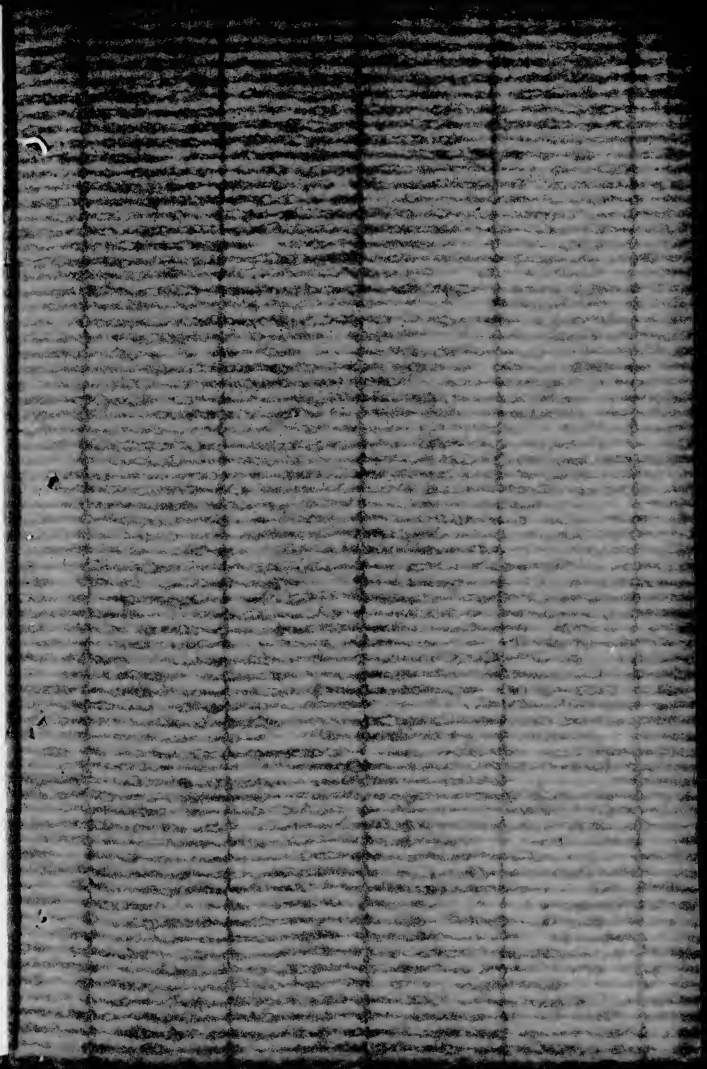
STEEL · · · BASIC

The diversification of activities in the technical branches of the steel industry makes it practically impossible for a weekly business paper to cover all important developments in detail. In order to improve service in this respect, "Steel" presents a comprehensive digest of all significant happenings in the technical branches of the steel industry in addition to its usual engineering articles. Thus for the first time, readers of "Steel" are given complete coverage of this essential department of the industry.

In recent years the character of copy in advertising has improved tremendously. Today advertising pages carry information comparing favorably with the editorial pages in point of interest and value to the reader. To stimulate the preparation of better advertisements and to encourage readers to derive the fullest values from advertising pages, advertising and editorial pages have been regrouped. The new make-up is advantageous to readers and advertisers alike.

In the main, the editorial policies which carried Iron Trade Review from obscurity to a position of high rank in business paper publishing remain unchanged. To "Steel" are given greater freedom of action and increased opportunities for editorial evaluation and interpretation. In every respect the publication is more closely attuned to swiftly moving events in the industry served.

Thus is "Steel," logical successor to Iron Trade Review! With "Steel" on the masthead; with steel, the material, to be exploited; and with steel, the industry, to be served, the course of the publication is charted definitely. And in striving to create an informed leadership among the rank and file of the industry; to facilitate the exchange of useful information on business, economic and technical matters; and to support all constructive movements affecting steel, the publication brings to its task new strength, clearer vision and a will to make "Steel" the true exponent of steel, the material.



STEEL
IRON
BRONZE
STONE

END OF
TITLE